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मानक

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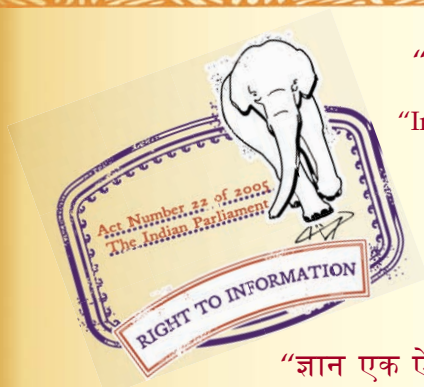
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“Step Out From the Old to the New”

IS 13431 (1992): Shipbuilding - Design, fabrication, installation and testing of ships' lubricating oil system - Code of practice [TED 17: Shipbuilding]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

पोतनिर्माण – पोत स्नेहन तेल तंत्र का संविरचन
संस्थापन और परीक्षण – रीति संहिता

Indian Standard

SHIPBUILDING – DESIGN, FABRICATION,
INSTALLATION AND TESTING OF SHIPS'
LUBRICATING OIL SYSTEM –
CODE OF PRACTICE

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Shipbuilding Sectional Committee had been approved by the Transport Engineering Division Council.

This standard has been prepared to specify recommendations and requirements for lubricating oil piping system in ships.

In preparing this standard due consideration has been given to factors involved and the current practice regarding the use of ferrous materials.

Attention shall be given to the design, fabrication and installation of systems to ensure streamlined flow. In particular, abrupt changes in the direction of flow, mismatched pipe bores, tube bores protrusions and other restrictions to flow shall be avoided.

At each stage of construction it is the responsibility of the user of this Indian Standard to ensure compliance with the requirements of the statutory authorities as applicable

In reporting the results of a test or analysis made in accordance with this standard, if the final value observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

SHIPBUILDING – DESIGN, FABRICATION, INSTALLATION AND TESTING OF SHIPS’ LUBRICATING OIL SYSTEM – CODE OF PRACTICE

1 SCOPE

1.1 This standard specifies requirements for the materials, design, installation, inspection and testing of lubricating oil piping systems in ships including all fittings which form part of such systems.

1.2 For the purpose of this draft standard, the lubricating oil piping system includes all pipes and fittings in the system.

2 REFERENCE

IS 2712 : 1979 ‘Compressed asbestos fibre jointings (*second revision*)’ is necessary adjunct to this standard.

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Manufacturer

The shipbuilder or authorised sub-contractor.

3.2 Piping System

All pipes, valves and fittings external to the machinery under lubrication.

3.3 Design Pressure

The maximum pressure to which the system can be subjected when in service is the value used in design calculations. But it shall not be less than the highest set pressure of the safety valve or relief valve, if provided.

3.4 Test Pressure

The pressure to which the system and its components are subjected under test conditions.

3.5 Purchaser

The ship owner or ship operator according to the circumstances of the particular ship.

4 RATING OF SYSTEM

4.1 The lubricating oil system consists of one or more independent systems, because of the different oil types, grades, quantities and pressures required.

5 MATERIALS AND COMPONENTS

5.1 Galvanized components shall be avoided in case of lubricants which react with zinc.

5.2 Pumps

5.2.1 Type and Selection of Pumps

Lubricating oil shall be generally supplied to machinery by positive displacement rotary pumps. The material of the components of the pump shall be compatible to the system requirement. The pump shall be capable of satisfactory performance when the ship is listed to the specified limits.

5.2.1.1 The pumps shall have in built safety valve or relief valve which shall be a part of the system.

5.2.1.2 Each lubricating oil pump shall be installed and driven by independent prime movers. The prime mover rating shall be determined by considering the oil viscosity when starting from cold. If necessary, two pumps shall be installed in each system, one as stand-by which shall be so installed and connected so as to be available for immediate use.

5.2.2 Capacity of Pumps

Capacity of lubricating oil pumps shall be selected so as to meet overall pressure and flow requirements for all bearing and machine elements in the system. The capacity and delivery pressure shall be as agreed to between the purchaser and the manufacturer.

5.2.3 Mounting of Pumps

5.2.3.1 Pumps shall be mounted in such a way that they are readily accessible for maintenance.

5.2.3.2 The mounting surface provided for the pump and prime mover shall be rigid preferably on a common base plate and be able to prevent coupling misalignment due to load and temperature variations.

5.2.3.3 If the cross head oil pump is connected in series with the lubricating oil pumps it shall be protected against dry running. Therefore these two pumps shall be wired up in such a way that the cross head oil pump can never be started first or continue to run upon complete failure of the lub oil pump.

5.3 Reservoirs

5.3.1 Oil Drain Tank

The lubricating oil tank shall be arranged as a part of the hull. The outlets from the bed plate bottom shall be arranged so that the return oil case can drain directly into the tank without resistance, irrespective of the ship's rolling and pitching. Each outlet shall be fitted with a strainer. The tank dimensions shall be related to the oil contents of the whole system. Scallop holes shall be provided in the tank for the free movement of oil to the suction point as per recommendation of the machinery manufacturer. The pump suction point shall be at the after end of the tank and reasonably away from the hot oil inlet.

5.3.1.1 The quantity of oil needed to obtain a reasonable oil circulating rate represents the oil volume remaining in the drain tank when the pump is in operation. The corresponding oil level is called the running level.

5.3.1.2 Adding to this oil quantity the volume of oil contained in the engine and in the installation piping shall give the total oil volume called "initial filling level".

5.3.1.3 The nett tank capacity shall not be less than 5 percent over the total oil volume.

5.3.1.4 All the oil pipes leading into the drain tank shall be below the minimum possible free oil level and must remain covered for any position of the ship, to avoid vapour formation by splashing hot oil.

5.3.1.5 Tank shall be equipped with oil level measuring device, heating coils if recommended by machinery manufacturer, vent pipes, filling line, drain line and connections to and from the separators.

5.3.2 Oil Storage Tank

5.3.2.1 Storage tank

Oil storage tank shall have a capacity of twice the volume of oil drain tank and to contain reserve quantity of oil. Arrangements shall be provided for filling the tank from deck on port and starboard side. Fittings shall include air pipe, sounding pipe, level gauge drains, outlet leading to oil drain tank, overflow and manhole doors.

5.3.2.2 Test cocks shall be provided at the bottom part of the service line to check the quality of oil.

5.3.3 Daily Service Tank

The purpose of this tank shall be to store minor grades of lubricating oil for daily use.

5.4 Heating and Cooling Arrangement

5.4.1 Heating Arrangement

Heating arrangements shall be provided in the tank if necessary for heating the oil to designed temperature conditions in order to maintain proper flow in the system and to aid initial circulation under cold start-up.

5.4.1.1 Heating arrangements provided in the tank for heating the oil shall be either by steam heating or by electric heating depending on the requirement and available facilities

5.4.2 Cooling Arrangement

5.4.2.1 Lubricating oil coolers shall be provided to remove the heat transferred to the lubricating oil. The lubricating oil cooler working pressure corresponds to the delivery pressure of lubricating oil pump. Normally plate or tubular heat exchangers are recommended. Number of coolers shall be decided according to the requirements.

5.5 Filtration

5.5.1 Three basic forms for removing foreign bodies shall be generally used in lubrication systems.

5.5.1.1 Coarse strainers

Coarse strainers shall be used to prevent large pieces of debris from getting into the system. Mesh size shall be 2-3 mm.

5.5.1.2 Magnetic flow strainers

These strainers shall be fitted in the system to remove ferrous particles.

5.5.1.3 Line filters

In oil circulation systems a filter is an essential component. One or more of the following three basic types of filters are recommended. However, for special applications machine manufacturer's recommendations may be followed:

- a) *Manually operated self cleaning filter* -- When this type of filter is used the pipe work shall normally be fitted with a by pass, so that the filter can be removed for maintenance.
- b) *Duplex filters* -- This type of filter allow each element to be manually cleaned in turn. No by-pass is necessary.
- c) *Automatic self cleaning filters* -- This type will clean themselves when the pressure drop across the element reaches a pre-designed value. The mesh size is 0.05 mm.

5.6 Oil Purifiers

Purification of oil is needed as it picks up contaminants while in circulation.

5.6.1 Purifiers shall be used in addition to the filter to purify the oil which can be contaminated with water and very small particles. It shall be large enough to regenerate the oil system contents 1.5 to 2 times within approximately 18 hours for manual cleaning or approximately 23 hours for self cleaning.

5.7 Control Valves

5.7.1 An automatic temperature control valve shall be provided to regulate the inlet oil temperature. This shall not be located at the highest point in the line in order to avoid an air pocket developing, which could lead to operating problems.

6 DESIGN OF PIPE LINE SYSTEM

6.1 General

6.1.1 In designing a lubricating oil system it shall be noted that certain configurations and some types of fittings which give an appreciable pressure loss shall be avoided, if possible.

6.1.2 Pipes used in the system shall comply with required pressure ranges and shall conform to relevant Indian Standards.

6.1.3 In order to keep pressure losses low, the pipe run shall be as short and direct as possible, tight right-angle bends and T-pieces shall be kept to a minimum.

6.1.4 The diameter of each pipe shall be determined from considerations of the oil flow quantities and a permissible 'maximum velocity — pipe diameter' specification.

6.2 Recommended Velocities

6.2.1 The oil velocities for pipes shall not exceed those specified. The values given in Table 1 are for guidance only.

6.3 Development of the Design

Following steps are involved:

6.3.1 Review basic design data including performance of identical/similar equipment in operation.

6.3.2 List pump sizes recommended by suppliers for a typical duty. List standard modules for pump and heat exchanger components of the main system.

6.3.3 Study purchaser's specification and note special requirements for pipe materials, valves, joints, fabrication and erection, testing and compatible to the system pressure and temperature requirement.

6.3.4 Study statutory and classification society requirements for the systems.

6.3.5 Establish if any special requirements are disclosed by the above procedures and if they conflict with standards normally followed by sub-contractors or builders. Initiate procedures to resolve points of difference and obtain outstanding information.

6.3.6 Preparation of Flow Diagram

6.3.6.1 Sketch single line flow diagram indicating pumps, heat exchangers, machinery units and ancillary unity specified (see Fig. 1 and 2).

Table 1 Recommended Velocities
(Clause 6.2.1)

Pipe Dia mm	32	40	50	65	80	100	125	150	175	200	225	250	300
SUCTION PIPE													
Velocity, m/s	0.4	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0
	to	to	to	to	to	to	to	to	to	to	to	to	to
	0.6	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.2
Flow rate, m ³ /h	1.2	2.3	4.2	7.2	13	20	31	51	69	90	129	159	254
	to	to	to	to	to	to	to	to	to	to	to	to	to
	1.7	3.2	5.6	9.6	16	25	40	64	86	113	157	194	306
DELIVERY PIPE													
Velocity, m/s	0.8	1.0	1.2	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.7
	to	to	to	to	to	to	to	to	to	to	to	to	to
	1.0	1.2	1.4	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.9
Flow rate, m ³ /h	2.3	4.5	8.4	15.5	25	40	62	95	130	169	228	282	432
	to	to	to	to	to	to	to	to	to	to	to	to	to
	2.9	5.4	9.8	18	29	45	71	108	147	192	257	318	484

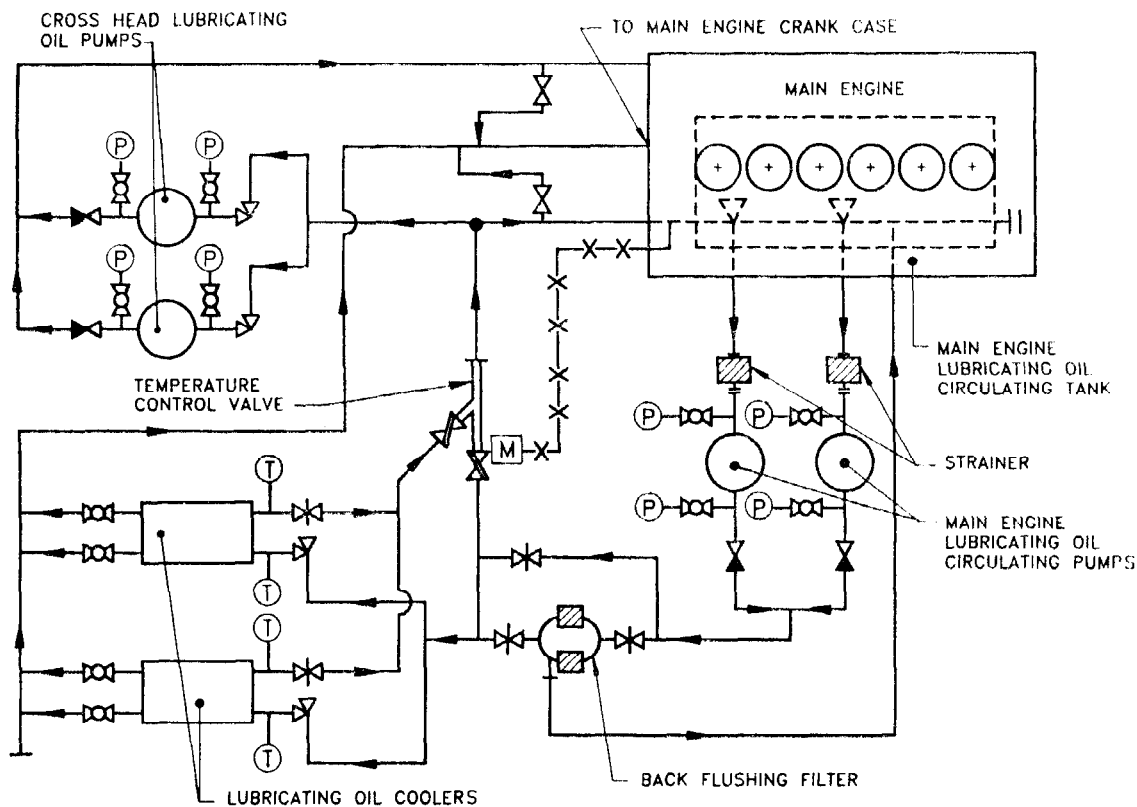


FIG. 1 TYPICAL SCHEMATIC ARRANGEMENT OF MAIN ENGINE LUBRICATING OIL CIRCULATING SYSTEM

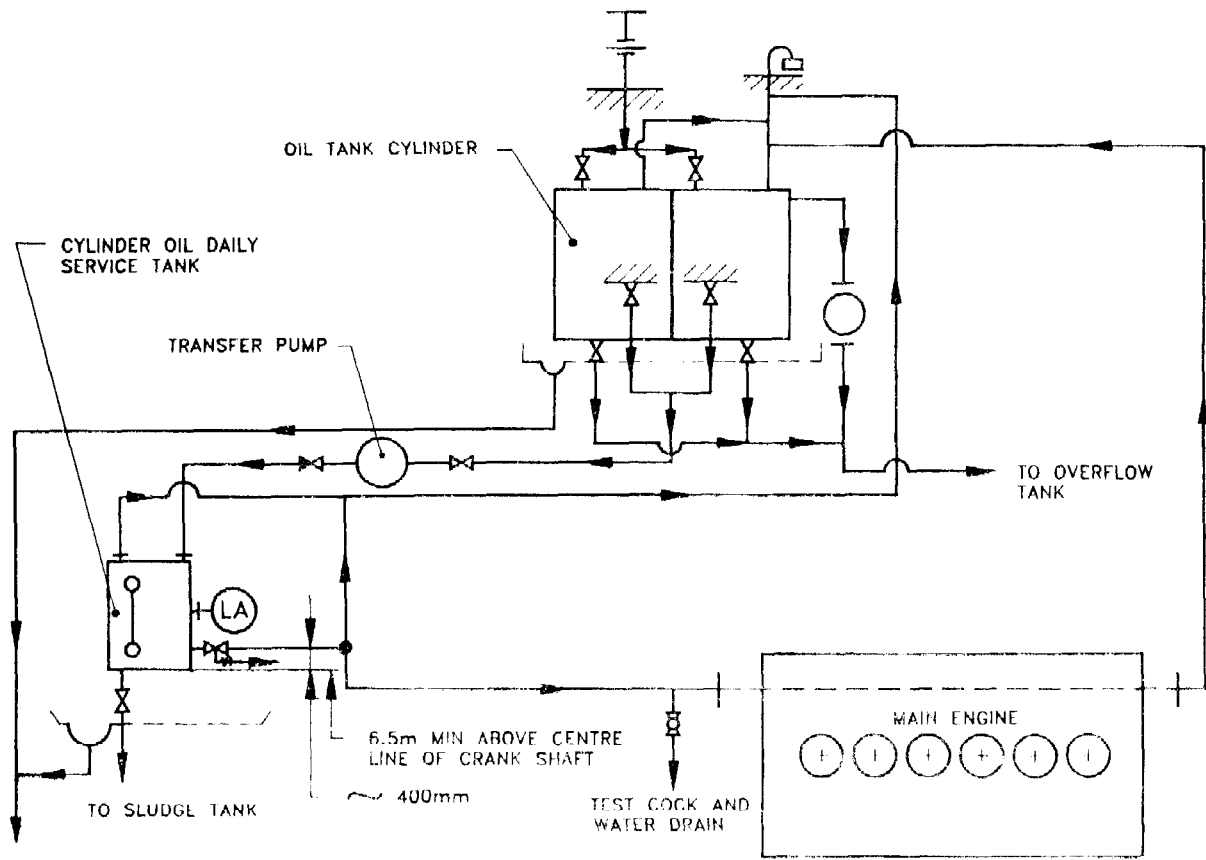


FIG. 2 TYPICAL SCHEMATIC ARRANGEMENT OF CYLINDER LUBRICATING OIL SYSTEMS

6.3.6.2 Add legend and a list of symbols and abbreviations which shall be used to identify pipeline fittings. Symbols used shall conform to relevant Indian Standards.

6.3.6.3 Add specified fittings to diagram, paying due regard to features mentioned elsewhere in this standard which shall keep flow resistance to near to the minimum for the pipe bore size adopted and allow preferential flow, for example through by passes where required.

6.3.6.4 Calculate flow quantities required in systems and matching pumps capacities.

6.3.6.5 Establish maximum velocities acceptable in system and calculate matching pipe size to add to diagram.

6.3.6.6 Make first order estimate of probable straight pipe lengths and static heads, list fittings and calculate probable flow resistance. This calculation shall be kept under review as the design is progressed. If the system resistance is higher than acceptable, the pipe bores shall be reconsidered and the calculation adjusted until the results are satisfactory.

6.3.6.7 Results obtained shall be checked with an economic analysis of the cost of pumping the quantity required with various flow resistance pumps, and pipe size to ensure they are compatible.

6.3.7 *Preparation of Isometric Sketches*

6.3.7.1 Flow paths can be readily visualized and piping layout generally decided by means of such sketches, which can be supplementary and/or alternative to flow diagrams and piping arrangement drawings.

6.3.7.2 Such isometric sketches shall show the general arrangement of equipment and piping, with limited details, to determine optimum lay out and nozzle orientation on equipment. Instrumentation requirements for pipe connections may also be determined.

6.3.8 *Ordering of Equipment*

6.3.8.1 Lists of special fittings required — e.g. special valves, control valves, spectacle pieces — shall be prepared from the available sketches. Preliminary requisitions for such fittings and for pumps piping, etc, shall be issued. Such requisitions shall be kept under review as the systems are developed.

6.3.9 *Piping Layout*

6.3.9.1 If model techniques are not employed, or alternative, permanent records of the layout found acceptable, it will be necessary to prepare pipe arrangement drawings. Such drawings shall:

a) Determine scale and show orientation.

b) Show the essential minimum detail of associated equipment and ship structure to determine system component locations and clearance. Such outlines shall contrast with piping.

c) Provide clearance for all equipment for access, maintenance and withdrawal, specially for crankshafts of engines, etc.

d) Provide accessibility to all system components which may require manipulations, inspection and maintenance.

e) Provide easily portable sections, short bends or make up pieces, to facilitate removal of equipments and fittings.

f) Show piping by single line except where double line is essential to demonstrate clearances.

g) Arrange pipe runs on fore and aft line or athwartships except where large size or other criteria justify the minimum length between two points being used. As far as possible the pipes shall be laid along the bulkhead, deckhead, shipside and under the floor plates so that space in the compartment can be utilized to the best possible extent.

h) Give preference to large bore pipe runs to give direct runs where possible and minimize fabrication costs. Such pipes to be routed to take advantage of ship structure for supports and pipe supports to be shown on drawing.

j) Keep the number of joints to a minimum practicable number.

k) Lay pipes in such a way that they shall not touch the tank top. It is advisable to give sufficient clearance between the pipes and the tank top to avoid pipes submerging in bilge water and also for inspection of the tank top and also opening flanges.

m) Show the essential minimum details of seatings of equipment, ladder ways, etc, to enable to design the fully coordinated pipe layout.

n) Specify provision for lifting eyes for removal of components over 50 kg weight.

p) Show the bends for pipes when running in straight length to compensate for expansion and contraction of the pipes.

q) Show suitable openings to be provided on floor plates wherever valves and fittings are located below floor.

r) Provide accessibility for the location where a closing length is to be made from dimensions lifted at site.

s) Avoid pockets and vertical loops where possible, but provide additional drains and vents where such configurations are unavoidable.

- i) Provide and indicate location of instrumentation system connections.
- u) Show enlarged details section to indicate orientation and flow direction through special control valves or other fittings which are unusual construction.
- v) Show component unit numbers of all pipes and fittings.
- w) Indicate non-standard joints, materials, fittings, testing procedures, purchaser's special requirements, etc, with drawings.
- y) Include essential dimensions for locating pipe centre lines in the ship where these may be required to produce pipe fabrication sketches or pipe support dimensions, and
- z) clearly indicate terminal points of lines where continuations will be arranged by other piping designers and detail connecting flanges.

6.3.10 Checking of System

On completion of the drawings the system resistance losses shall be re-calculated, the pipe and fitting schedules reviewed and requisitions for equipment confirmed.

6.4 Pressure Loss Through Proprietary Items

The pressure loss through proprietary items, such as coolers may be obtained from the manufacturer's specification. The extra losses to be determined are those occurring in the pipes, valves, bends and other fittings.

7 PIPE WORK FLEXIBILITY, SUPPORT AND INSTALLATION

7.1 Flexibility of Piping Systems

7.1.1 Piping systems shall be designed with adequate flexibility so that expansion of the piping and machinery, vibration and working of the ship shall not result in overstressing of the system or leakage at joints.

7.1.2 Flexibility shall normally be provided by the use of plain piping bent to normal specified radius, loops and off sets in the piping.

7.1.3 Where space limitations prevail or where piping is to be attached to resiliently mounted machinery use may be made of flexible pipes or bellows expansion pieces. They shall be installed in unstressed condition.

7.2 Flexible Piping Units or Assemblies

7.2.1 The design and construction of these components shall be suitable for the pressure, vacuum and temperature under all conditions likely to occur in service, including ambient temperature and shall also be capable of absorbing the movements imposed by attached machinery and pipe work.

7.2.2 The material of these components including any fittings if separately attached, shall be suitable for containing lubricating oil and be compatible with the material of the piping system to which they are attached.

7.2.3 Flexible pipes shall be limited to small lengths only.

7.3 Pipe Supports

7.3.1 General Design

7.3.1.1 Pipelines shall be routed to enable the surrounding structure to provide logical points of support, anchorage, guidance or restraint. Supporting of the largest of critical piping systems shall take priority over other and the location of supports and anchors shall be shown on arrangement drawings.

7.3.1.2 The design of supports is to be capable of adequately supporting the piping system without undue distortion. In addition to pipeline gravitational loads the supports shall provide for concentrated loads imposed by valves and risers, for axial loadings due to expansion and the pressure of fluid, and for inertia effects due to ship movements. Hangers for supports shall be provided close to concentrated weights, at horizontal changes in line direction, and on or adjacent to pipe risers.

7.3.1.3 Pipe work adjoining flexible units shall be supported as closely as possible to the flexible unit. The supports shall be designed to prevent the pressure loads transmitted by the flexible unit distorting the attached pipe work and equipment.

7.3.1.4 The intervals of supports for pipes shall be decided according to the bore and configuration of pipe work consistent with normal shipbuilding practice.

7.3.1.5 All pipe work shall be examined during the sea trial to determine whether additional hangers are necessary due to unforeseen vibrations.

7.4 Piping Installation

7.4.1 Pipe Jointing

7.4.1.1 General

Jointing material shall conform to Grade B/O of IS 2712 : 1979. Other materials may be adopted by agreement between the purchaser and the manufacturer.

Jointing material shall be pre-cut and so dimensioned that it will not project into the bore of the pipe. It is recommended that the gaskets be full face and located on the bolts except where raised face flanges are in use.

7.4.2 Pipe Erection

7.4.2.1 Flange face shall be closely mated and bolt holes in alignment before making up the joints. The pipes shall not be strained into position in order to make them fit. Pipes which do not fit satisfactorily shall be returned to the workshop for correction and re-stress relieving where necessary.

7.4.2.2 Mating pipes, valves and fittings shall be installed with their bores concentric and in line and care taken to ensure that any jointing fitted does not protrude into the bore.

7.4.2.3 Care shall be taken with alignment of piping when making screwed, brazed or welded joints.

7.4.2.4 The installation of bellow pieces or flexible units shall be carefully carried out to ensure that they are not pre-stressed.

7.4.2.5 The closing length of piping shall be manufactured to a sufficient degree of accuracy so that it can be fitted in place without undue manual effort.

8 INSPECTION AND TESTING

8.1 Component Inspections and Tests Before Installation

8.1.1 Cleaning of Pipes

Pipes shall be internally cleaned and made free from scales. If conditions like corrosive atmosphere exists, pipes shall be suitably protected on the exterior. Where fabricated pipe work is to be used, pipes shall be shot blasted or pickled in random lengths before fabrication.

8.1.2 Shop Inspection

- a) All components shall be checked to ensure that they are correct and in accordance with drawings, especially details of terminals and materials.
- b) All components shall be visually examined for faults and irregularities.
- c) Welded and brazed joints shall be examined to ensure that fillets are regular and continuous in form. Wherever practicable it shall be established that there is no lack of root penetration, or evidence of non-fusion or burn through/excessive penetration, of the pipe in way of the joint.

8.1.3 Shop Test

Each completed pipe and fitting shall be hydraulically tested to 1.5 times the maximum pressure to which the system can be subjected under service conditions.

8.1.3.1 Hydraulic tests and capacity tests for pumps

- a) All pumps intended for essential services are to be tested manufacturer's works hydraulically and for specified capacity performance;
- b) Pump housings and cylinders are to be tested to 1.5 times the working pressure; and
- c) Pump capacities are to be checked with the pump running at rated speed with rated pressure head. Capacity test may be dispensed with, when satisfactory tests have been carried out on similar pumps.

8.1.3.2 The completed pipes and fittings shall be tested with fresh mains water with filling, air evacuation and test gauge connections provided. The test pressure shall be maintained for not less than two minutes after the filling valve is closed to demonstrate the integrity of all connections. After testing all such components shall be drained and pickled or cleaned again. All terminals shall be blanked before the component is despatched to the ship.

8.2 System Inspections and Tests After Installation

8.2.1 System Inspections After Installation

Before any testing is carried out the system shall be inspected to check that:

- a) Pipes are painted as per the colour code where required. The colour of the paint on the pipes shall be as specified in relevant Indian Standards.
- b) The installation is in accordance with the pipe arrangement drawings.
- c) The location and fitting of supports and hangers are adequate.
- d) The joints are accessible for maintenance.
- e) The fittings are installed correctly for the required direction of flow, especially valves and filters.
- f) The valves are accessible for operation and maintenance.
- g) Loads are not imposed on pump castings and other fixed components due to distortion of pipes or lack of support of adjoining fittings.
- h) All valves and necessary remote controls can operate through their full limits open-shut-open.
- j) All bellow pieces and flexible pipes are installed correctly within the operating limits specified.
- k) Pumps are fitted with required suction and discharge pressure gauges, and
- m) Valves and fittings are correctly labelled.
- n) Where relief valves, reducing valves and thermostat operating valves are fitted, they are to be set to the requisite pressure and temperature.
- p) The pipes do not touch each other or any fittings or any structural member except at the point of clamping.

9 INSTRUMENTATION AND CONTROL

9.1 Different instruments such as thermometers, pressure gauges, level indicators, thermostats, pressure switches, flow switches, etc, shall be used for indicating the system conditions and also for controlling the conditions within the required limits.

9.2 Methods of Warning of System Failure

Lights and audible alarms shall be installed on the system to indicate the failure of the lubrication system. Where forced lubrication system is employed and alternate pump facility exists, automatic cut-in device is to be provided.

9.2.1 Initiation of Warning

Flow switches, level switches, pressure switches, etc, shall be used to initiate the warning of the system failure.

9.2.2 The use of audible alarms is recommended to indicate the following:

- a) Lubricant level in tanks (high and low)
- b) Low pressure/low flow rate in system
- c) High and low temperature

10 COMMISSIONING

10.1 To ensure the proper commissioning of system following operations shall be carried out:

- a) Cleaning of pipes
- b) Checking the main items of equipment and control device
- c) Flushing as required
- d) Refitting of all drain plugs
- e) Filling of system
- f) Setting of operating conditions
- g) Running tests to prove the system
- h) Checking for leaks
- j) All filter elements shall be finally cleaned where required before final handing over to the purchaser.

11 FLUSHING OF LUBRICATING OIL PIPE LINES

11.1 Flushing Medium

The system shall be circulated by flushing oil or system oil.

11.2 Flushing Method

11.2.1 Before Flushing

- a) Prior to flushing all internal pipe lines inside the main engine shall be disconnected so as to ensure that the flushing oil does not enter the engine bearings, gears and other moving parts, having fine clearances.
- b) Before starting flushing, it is to be confirmed that lubricating oil drain tank, other lubricating oil tanks and main engine crank case are sufficiently cleaned to be ready for flushing.
- c) Also confirm that the filters (about 200 mesh) are fitted to the strainers on suction and delivery side and magnets are properly installed.

11.2.2 During Flushing

- a) The flushing temperature to be dependent on type of oil (about 40 to 55°C).
- b) Flushing is to be carried out at least for a period of 24 hours. In any case it has to be continued until filters are found to be maintained in a similar condition for over two hours by periodical inspection.

12 SEA TRIAL

12.1 System Tests

- a) The system shall be circulated with oil at the maximum pressure attainable by the pumps under normal service conditions.
- b) All air valves shall be operated to ensure that air is released from high points.
- c) The system shall be examined for leaks from joints and glands.
- d) A note shall be made of undue noise and vibration and additional supports fitted where necessary.
- e) The temperature and pressure controls in lubricating oil systems are very important for the proper functioning of the engines. Control valves to be arranged as per the engine manufacturer's recommendation.

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(Common to all Offices)

Regional Offices:

Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002

{ 331 01 31
{ 331 13 75

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054

{ 37 84 99, 37 85 61,
{ 37 86 26, 37 86 62

Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036

{ 53 38 43, 53 16 40,
{ 53 23 84

Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113

{ 235 02 16, 235 04 42,
{ 235 15 19, 235 23 15

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
BOMBAY 400093

{ 632 92 95, 63 27 80,
{ 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE.
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